MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

TCV3151 – COMPUTER VISION

(All sections / Groups)

19 OCTOBER 2018
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages with 5 questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the answer booklet provided.

QUESTION 1

(a) Describe two specific applications in which computer vision techniques have been used successfully. Specify in some detail the techniques used in each case. [4 marks]

(b) Figure 1.1 shows the progressive results of quantizing a gray-level image.

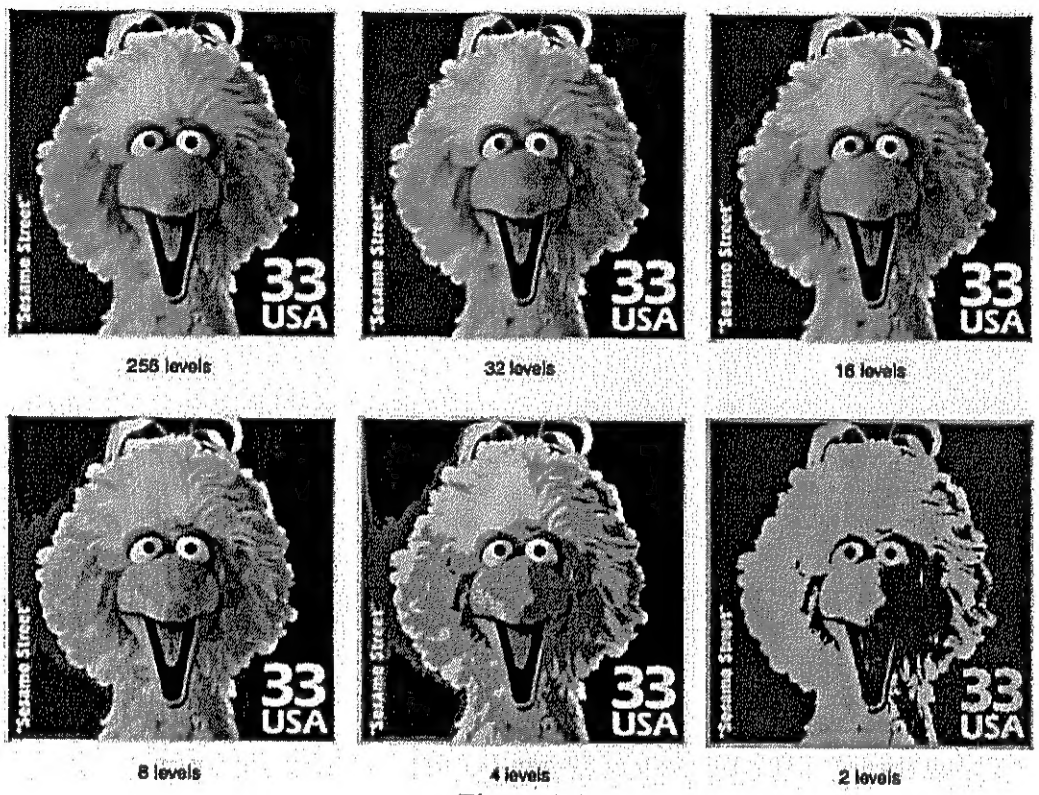

Figure 1.1

(i) What is quantization in digital image processing? [1 mark]

(ii) What affects do you observe when the quantization levels are reduced in Figure 1.1? [2 marks]

(iii) Do you think quantization is reversible? [1 mark]

Continued .....

(c) Name the type of connectivity (i.e. 4-connectivity or 8-connectivity) for the following figures. [2 marks]

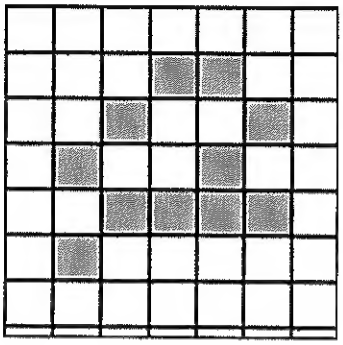

Figure 1.2

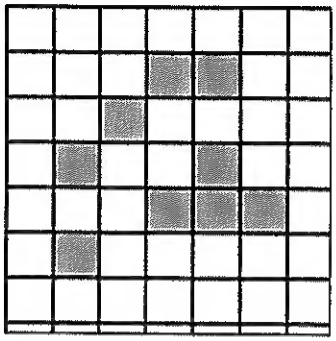

Figure 1.3

Continued .....

QUESTION 2

(a) Image enhancement approaches fall into two broad categories. Explain the approaches in the two categories. [2 marks]

(b) Consider the original image depicted in Figure 2.1. Explain the point processing operation could have been applied to obtain the result shown in Figure 2.2. Plot the point processing operation. [3 marks]

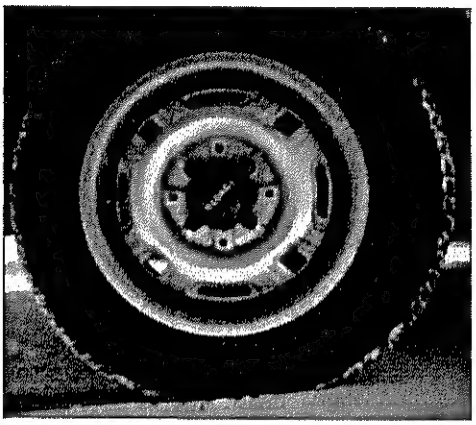

Figure 2.1

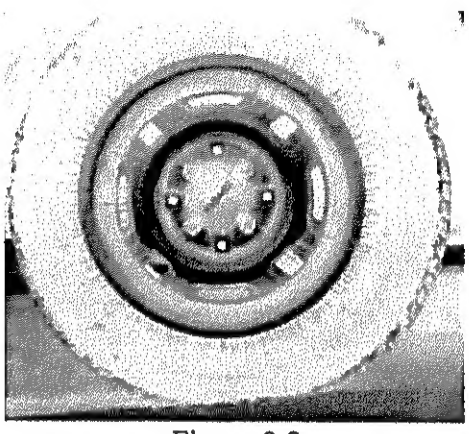

Figure 2.2

(c) Histogram processing is one of the key techniques used in digital image processing.

(i) Define histogram. [1 mark]

(ii) What is meant by histogram equalization? [1 mark]

(iii) Apply histogram equalization on a 4-by-4 digital image in 8 gray levels shown in Figure 2.3. Sketch the histograms before and after applying histogram equalization on the image. [3 marks]

6	7	5	6
6	4	5	5
4	7	0	5
5	6	5	5

Figure 2.3

Continued .....

QUESTION 3

(a) Give the difference between image enhancement and image restoration. [2 marks]

(b) A 3-bit image of size 4-by-4 is shown in Figure 3.1.

1	4	5	1
2	2	4	2
1	0	1	0
1	2	1	0

Figure 3.1

(i) Apply a 3 × 3 average filter on the image. Extend the border values outside with values at the boundary. [2 marks]

(ii) Assume that the image in Figure 3.1 is corrupted with a considerable amount of salt and pepper noise. Do you think average filter can remove the salt and pepper noise effectively? Why? [2 marks]

(iii) Do you think median filter can be better than average filter in removing the salt and pepper noise? Why? [2 marks]

(c) Figure 3.3 depicts the output of enhancing Figure 3.2 using a Laplacian filter. Figure 3.4, on the other hand, represents the output of applying a Gaussian filter before applying the Laplacian filter on the original image. Which output is more appealing (Figure 3.3 or Figure 3.4)? Why? [2 marks]

Figure 3.2

Figure 3.3

Figure 3.4

Continued .....

QUESTION 4

(a) Define an edge. State the goal of edge detection. [2 marks]

(b) Consider an image containing strong illumination gradient shown in Figure 4.1. The histogram for this image is given in Figure 4.2.

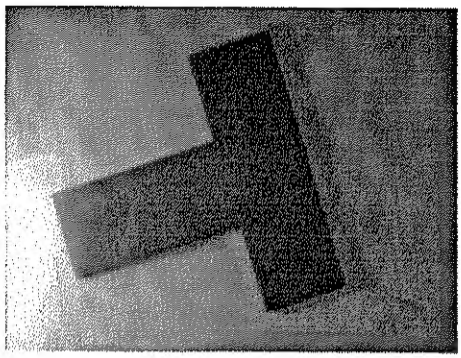

Figure 4.1

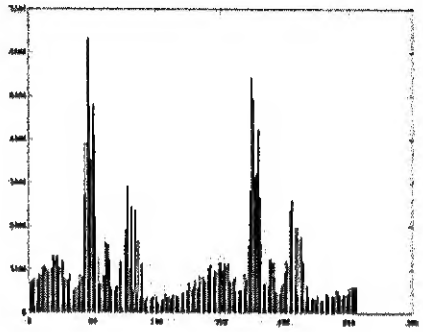

Figure 4.2

(i) What is the problem related to choosing a suitable threshold for this image? [1 mark]

(ii) Propose a suitable method that could be used to perform successful segmentation for this image. [2 marks]

(c) Explain how gray-level co-occurrence matrix (GLCM) can be used for texture analysis. [2 marks]

(d) Given a sequence of images showing the movement of an object through four frames illustrated in Figure 4.3. Find the Accumulative Difference Pictures (ADP) for these image frames. The α_t values have been given for each frame. [3 marks]

1	1	1	0
0	1	1	0
0	1	1	1
0	0	1	1

0	1	1	1
0	0	1	1
0	0	1	1
0	0	0	1

$\alpha_2 = 2$

0	0	1	1
0	0	0	1
0	0	0	1
0	0	0	0

$\alpha_2 = 4$

0	0	0	1
0	0	0	0
0	0	0	0
0	0	0	0

$\alpha_3 = 6$

Figure 4.3

Continued .....

QUESTION 5

(a) Why do you think intra-class variation and deformation pose great challenges to object recognition? Explain your answer. [2 marks]

(b) True/False: Given a set of three images shown in Figure 5.1, finding and labelling the image in the centre as "containing a cat" is considered a detection task in object recognition. Justify your answer. [2 marks]

Figure 5.1

(c) Many computer vision algorithms such as SIFT (scale-invariant feature transform) seek to detect and analyse features at multiple scales of analysis.

(i) List FOUR characteristics of the features extracted by SIFT. [2 marks]

(ii) Do you think Difference of Gaussian images are equivalent to the Laplacian of Gaussian? Justify your answer. [2 marks]

(iii) Briefly describe how the SIFT features can be used for object recognition. [2 marks]

End of Page